

## WHAT IS CLAIMED

Claim 1. A method for the manufacture of a projectile for small-bore weapons ammunition comprising the steps of

5 introducing a quantity of a mixture of a heavy metal powder and a light metal powder into a die cavity

10 pressing said first quantity of said mixture in said die cavity at approximately room temperature into a first discrete non-sintered self-supporting compact having a body portion of substantially straight cylindrical geometry and having first and second opposite ends and a longitudinal centerline,

15 without further treatment of said first compact, introducing said first compact into a jacket having a generally cylindrical internal volume defined by an internal wall, an open end and a closed end and a longitudinal centerline,

20 at approximately room temperature and employing axially applied pressure, pressing said first compact into said jacket to position said first compact with said first end thereof disposed adjacent said closed end of said jacket and substantially filling the volume of said jacket adjacent said closed end thereof,

25 introducing a further quantity of said mixture or a quantity of another mixture of a heavy metal powder and a light metal powder into a die cavity,

30 pressing said further quantity of said mixture or a quantity of said another mixture in a die cavity at approximately room temperature into a second non-sintered self-supporting discrete compact having a body portion of substantially straight cylindrical geometry and having first and second opposite ends and a longitudinal centerline,

35 without further treatment of said second compact,

introducing said second compact into said jacket with its first end disposed in abutting relationship with said second end of said first compact and with the centerlines of said first and second compacts in alignment with one another and with the centerline of said jacket,

introducing within said jacket and in abutting relationship to said second end of said second compact a disc having an outer diameter substantially equal to the internal diameter of said jacket adjacent said second end of said second compact,

at approximately room temperature and employing axially applied pressure against said separator disc, pressing said second compact against said first compact with a pressure sufficient to cause said second compact to substantially fill its respective volume of said jacket and to cause first and second compacts to substantially fill said jacket between said closed end of said jacket and said second end of said second compact, leaving a portion of said open end of said jacket void of said compacts and said separator disc,

infolding said open end of said jacket in a direction toward said centerline of said jacket and against at least a portion of said second end of said second compact and said disc to substantially close said open end of said jacket, said infolding of said open end of said jacket deforming said second end of said second compact and said disc to define a leading end of said projectile.

Claim 2. The method of Claim 1 wherein said infolding of said open end of said jacket incompletely closes said open end.

Claim 3. The method of Claim 1 wherein the filled internal volume of said infolded open end of said jacket is less than the full internal volume of said jacket, leaving a portion of said internal volume of said jacket adjacent said incompletely closed end thereof void of said compacts and said

disc.

Claim 4. The method of Claim 1 and including the step of interposing a second disc in overlying and abutting relationship to said second end of said first compact and said first end of said second compact, said disc being positioned within said jacket prior to the pressing of said first compact into said jacket and oriented in a plane that is substantially normal to said longitudinal centerline of said jacket.

Claim 5. The method of Claim 1 and including the steps of pressing in a die cavity at approximately room temperature a third discrete non-sintered self-supporting compact from a quantity of said mixture of metal powders, said another mixture of metal powders, or a further mixture of a heavy metal powder and a light metal powder, said compact having a body portion of generally cylindrical geometry, first and second opposite ends and a longitudinal centerline, without further treatment of said third compact, introducing said third compact into said jacket intermediate said second compact and said disc with said first end of said third compact abutting said second end of said second compact and with their centerlines aligned, and at room temperature and employing axially applied pressure, pressing said third compact against said first and second compacts.

Claim 6. The method of Claim 1 wherein said infolding of said open end of said jacket includes the formation of an ogive on said open end of said jacket.

Claim 7. The method of Claim 1 wherein each of said cold pressed compacts exhibits a density distribution that is substantially uniform in a direction radially of said centerline of said jacket in a plane normal to said centerline of said jacket.

Claim 8. The method of Claim 1 and including the step of mixing with said heavy metal powder and said light metal powder a non-metal matrix powder which is carried with each of said compacts into said projectile.

Claim 9. The method of Claim 1 wherein the pressure employing in cold pressing each of said compacts in a die cavity is between about 10,000 psi and 310,000 psi.

Claim 10. The method of Claim 1 wherein said heavy metal powder comprises tungsten metal powder.

Claim 11. The method of Claim 1 wherein said light metal powder comprises tin, zinc, lead, aluminum, magnesium, bismuth, antimony or a combination thereof, or a plastic material.

Claim 12. The method of Claim 1 wherein said heavy metal powder is present in said mixture at a percentage by weight of between about 20 and less than 100.

Claim 13. The method of Claim 1 wherein each of said pressed compacts exhibits a crush strength of about 200 psi.

Claim 14. The method of Claim 1 wherein the overall density of each of said pressed compacts is greater than the density of lead.

Claim 15. The method of Claim 1 wherein the overall density of each of said pressed compacts is greater than about 17 gm/cc.

Claim 16. The method of Claim 1 wherein the density of each of said compacts is greater adjacent their opposite ends than in that portion of each compact intermediate its opposite ends.

Claim 17. The method of Claim 1 wherein the overall weight of said projectile is between about 60 and 1000 grains.

Claim 18. The method of Claim 1 wherein said projectile is suitable for firing in a weapon designed to accept 5.56mm ammunition.

Claim 19. The method of Claim 18 wherein said 5.56mm weapon includes a barrel having a length of between 10.5 inches and 26 inches and a 7 twist rifling.

Claim 20. The method of Claim 1 wherein each of said first and second compacts is of substantially the same diameter and wherein said step of pressing each of said compacts into said jacket functions to cause flow of powder particles of a respective compact at least generally radially of said respective compact to thereby fill any void space between said respective compact and that portion of said internal wall of said jacket adjacent said respective compact.

Claim 21. The method of Claim 1 wherein the outer diameter of each of said compacts is less than the internal diameter of said jacket whereby each of said compacts may be inserted into said jacket without dislodgement of metal powder particles from said compact in the course of its introduction into said jacket.

Claim 22. The method of Claim 21 wherein the outer diameter of each of said compacts is at least about 0.002 inch less in diameter than the internal diameter of said jacket.

Claim 23. The method of Claim 22 wherein said jacket exhibits a minimum diameter in the region thereof adjacent its closed end and the maximum outer diameter of each of said compacts is at least about 0.002 inch less in diameter than said minimum diameter of said jacket.

Claim 24. A projectile for weapon ammunition comprising

5 a metal generally cup-shaped jacket having a closed end, an open end, an internal volume of generally cylindrical geometry and a longitudinal centerline,

10 a first discrete compact which is cold-pressed from a mixture of a heavy metal powder and a light metal powder and having first and second opposite ends, a substantially cylindrical body portion disposed between said first and

second ends and a longitudinal centerline, said first compact being disposed within said jacket with said first end thereof abutting said closed end of said jacket and substantially filling said jacket in the region adjacent said closed end of said jacket,

a second discrete compact which is cold-pressed from a mixture of a heavy metal powder and a light metal powder and having first and second opposite ends, a substantially cylindrical body portion disposed between said first and second ends and a longitudinal centerline, said second compact being disposed within said jacket with said first end thereof disposed in abutting relationship to said second end of said first compact and substantially filling that portion of said internal volume of said jacket adjacent said second compact, said centerlines of said first and second compacts being aligned with one another and with said centerline of said jacket,

a disc disposed within said jacket in overlying and abutting relationship to said second end of said second compact, said first and second compacts and said disc incompletely filling said internal volume of said jacket whereby a portion of said jacket projects beyond said disc,

said portion of said jacket which projects beyond said disc and toward said open end of said jacket being infolded toward said centerline of said jacket to capture said disc and compacts within said jacket and wherein at least a portion of said second end of said second compact and said disc are deformed to conform to at least a substantial portion of the internal volume of said jacket as deformed by said infolded portion of said jacket.

Claim 25. The method of Claim 24 wherein said infolded end of said jacket incompletely closes said open end of said jacket.

Claim 26. The projectile of Claim 24 wherein each of

said discrete compacts comprises a mixture of a heavy metal powder and a light metal powder pressed into a self-supporting non-sintered compact in a die cavity at approximately room temperature, and each of said compacts is introduced into said jacket without further treatment thereof.

5 Claim 27. The projectile of Claim 24 and including a third discrete compact comprising a mixture of a heavy metal powder and a light metal powder pressed into a self-supporting non-sintered compact in a die cavity at approximately room temperature, said third compact including first and second  
10 opposite ends, a generally cylindrical body portion intermediate said opposite ends, and a longitudinal centerline, said third compact being disposed within said jacket without further treatment thereof following its formation and between said second end of said second compact and said open end of said jacket and having its longitudinal centerline aligned with the longitudinal centerlines of said first and second compacts and said jacket.

Claim 28. The projectile of Claim 27 and including a disc disposed between said second end of said third compact and said open end of said jacket.

Claim 29. The projectile of Claim 24 and including a further disc disposed between said abutting second end of said first compact and said first end of said second compact, said disc overlying said second end of said first disc and being oriented in a plane that is substantially normal to the longitudinal centerline of said jacket.

5 Claim 30. The projectile of Claim 29 and including a disc disposed between the abutting second end of said first compact and said first end of said second compact and a disc disposed between the abutting second end of said second compact and said first end of said third compact, each of said discs being disposed in overlying relationship to their respective ends of said compacts and oriented in respective planes, each of which is oriented substantially normal to said longitudinal centerline

of said jacket.

Claim 31. The projectile of Claim 24 wherein each of said compacts is of substantially uniform density radially of said centerline of said compact and in a plane normal to said centerline of said compact.

Claim 32. The projectile of Claim 24 wherein each of said compacts is of a density greater than the density of lead.

Claim 33. The projectile of Claim 24 wherein said first compact is of a first overall density and said second compact is of a second overall density, the overall density of each projectile being greater than the density of lead.

Claim 34. The projectile of Claim 24 wherein each of said first and second compacts are of substantially identical diameters prior to their being pressed into said jacket.

Claim 35. A method for the manufacture of a round of ammunition suitable to produce subsonic flight of a projectile to a target from a weapon fired in the semi-automatic or automatic mode and having a closed gas system for operation of the bolt of the weapon comprising the steps of

introducing into a cartridge case suitable for receipt in the firing chamber of the weapon and having a closed end and an open end and for firing a projectile from the weapon, a quantity of slow burning gun powder to partially fill said case,

disposing in said open end of said case, a projectile having an overall weight substantially in excess of the overall weight of a comparable sized lead projectile, said projectile closing said open end of said case and extending into said case a distance of at least about one-third of the length of said case, but terminating short of said gun powder present in said case and with at least a portion of said projectile projecting beyond said closed end of said case,



said combination of weight of said projectile and said quantity of gun powder being sufficient to produce sufficient gas pressure within the closed gas system of the weapon to consistently operate the bolt of the weapon.

Claim 36. The method of Claim 35 wherein the overall length of the cartridge permits the feeding of multiple ones of the cartridges, one at a time, from a magazine and into the firing chamber of the weapon.

Claim 37. The method of Claim 35 and including the step of forming said projectile from a metal jacket having an open end and an internal volume, and a core comprising a plurality of discrete compacts disposed within said jacket, each of said compacts being formed from a mixture of a heavy metal powder and a light metal powder to form a compact which is of generally straight cylindrical geometry having first and second ends and a cylindrical body portion intermediate said ends, said compact having a density greater than the density of lead a length which is less than the full desired length of said core, the combined lengths of said plurality of compacts incompletely filling said jacket and leaving a portion of said jacket adjacent said open end thereof void of said compacts, and thereafter infolding said portion of said jacket which is void of said compacts to at least substantially close said open end of said jacket, said infolding causing at least a portion of that compact adjacent said open end of said jacket to at least partially fill said infolded portion of said jacket.

Claim 38. The method of Claim 35 and prior to infolding of said open end portion of said jacket, including the step of interposing within said jacket a separator disc in abutting relationship to that end of said compact which is proximate said open end of said jacket.

Claim 39. A cartridge suitable to produce subsonic flight of the projectile to a target from a weapon fired in the semi-automatic or automatic mode and having a closed gas system for operation of the bolt of the weapon comprising

a cartridge case having a closed end and an open end and suitable for firing a projectile from the weapon, a quantity of slow burning gun powder partially filling said case,

a projectile having an overall weight substantially in excess of the overall weight of a comparable sized lead projectile disposed in said open end of said case, said projectile closing said open end of said case and extending into said case a distance of at least about 35%, and preferably about 42%, of the length of said case, but terminating short of said gun powder present in said case and with at least a portion of said projectile projecting beyond said closed end of said case, said combination of weight of said projectile and said quantity of gun powder being sufficient to produce sufficient gas pressure within the closed gas system of the weapon to consistently operate the bolt of the weapon, said cartridge and projectile having an overall length which permits the feeding of multiple ones of the cartridges, one at a time, from a magazine and into the firing chamber of the weapon,

said projectile being formed of a metal jacket having a closed end, an open end and an internal volume, and a core comprising a plurality of discrete compacts disposed within said jacket, each of said compacts being formed from a mixture of a heavy metal powder and a light metal powder to form a compact which is of generally straight cylindrical geometry having first and second ends and a cylindrical body portion intermediate said ends, said compact having a density greater than the density of lead a length which is less than the full desired length of said core, the combined lengths of said plurality of compacts incompletely filling said jacket and leaving a portion of said jacket adjacent said open end thereof void of said compacts, and thereafter infolding said portion of said jacket which is void of said compacts to at least substantially close said open end of said jacket, said infolding causing at least a portion of that compact adjacent said open end of said jacket to at least partially fill said infolded portion of said jacket, and a separator disc interposed within said jacket in abutting relationship to that

end of said compact which is proximate said open end of said jacket.

Claim 40. The round of ammunition of Claim 39 wherein each of said compacts is formed with a maximum outer diameter that is less than the minimum internal diameter of said jacket and each of said compacts is pressed into said jacket by an axially applied pressure which is sufficient to ensure that deformation of said compact which causes said compact to substantially fill that portion of the volume of said jacket which is adjacent said compact.